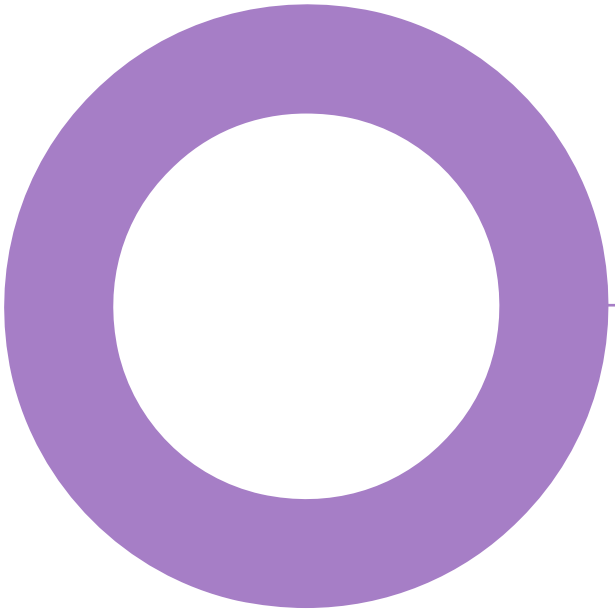
HOARE LEA

TK Maxx Camden.
128-138 Camden High Street.
TJX Europe.

ACOUSTICS
NOISE IMPACT ASSESSMENT

REVISION 01 – 30 JULY 2020



Audit sheet.

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Contents.

Executive summary.

Hoare Lea has conducted an environmental noise survey for the proposed TK Maxx Store at 128-138 Camden High Street.

The following summarises the assessment procedure and findings contained within this report:

- Unattended noise monitoring was conducted throughout a typical five-day period.
- Background noise levels typical of the daytime have been measured and used to define building services plant noise emission limits at the nearest noise sensitive receptors.
- The nearest noise sensitive receptors have been identified as an existing residential dwelling within 14 Greenland Street to the north of the proposed store.
- It is understood that the store opening hours are 0900 to 1900 Monday to Saturday and 1200 to 1800 on Sundays, and that the proposed building services plant will operate for a maximum of an hour before the store opens and after the store closes (0800 to 2000 Monday to Saturday and 1100 to 1900 on Sunday).
- During the time in which the plant will be operational, the combined building services plant noise emission contribution limit advised is 41 dB(A), one metre from the nearest noise sensitive receptor.
- An assessment of noise associated with the proposed items of building services plant has been undertaken. The predicted noise level exceeds the defined noise emission limit by up to 11 dB(A). As such, noise control measures of the air handling unit and condenser unit 01 is required.
- In order to provide sufficient attenuation of the supply and extract fan of the air handling unit, silencers of length 600mm and free area 50% and 33% are required.
- In order to provide sufficient attenuation of condenser unit 01, three options are provided for consideration:
    1. Provide a solid acoustic screen (minimum 20 kg/m^2) to prevent a direct line of sight between the condenser unit and the residential window at 14 Greenland Street. In practice, this could be achieved with a solid acoustic screen with an angled return on the top.
    2. Provide the condenser unit with a full acoustic kit as manufactured by Mitsubishi.
    3. Reselect the condenser unit to have maximum sound power level of L_{wA} 74 dB.
- Incorporation of these mitigation measures is sufficient to provide noise emissions in compliance with the defined noise emission limit.

1. Introduction.

Hoare Lea Acoustics has been appointed by TJX Europe to conduct an environmental noise survey in order to support the planning application for the installation of two air conditioning units and an air handling unit as part of the TK Maxx Store at 128-138 Camden High Street.

An environmental noise survey is required to quantify the existing ambient and background noise levels at the site in order to assess the potential noise impact from the air conditioning units associated with the development.

This report provides a description of the results from the noise survey undertaken and an assessment to determine external noise limits for building services plant required to meet the Local Authority's general noise emission limits. This report also provides an assessment indicating how the new mechanical services plant associated with the development will comply with the external noise limits.

To aid in the understanding of the assessment, definitions of technical terms used have been included in Appendix A.

2. Site description.

The proposed TK Maxx Store is the former Waterstones and Poundland store located at 128-138 Camden High Street in the London Borough of Camden. The site is bound by Camden High Street to the west, Greenland Street to the north and Bayham Street to the east.

The surrounding buildings on Camden High Street are generally commercial in nature, providing a mixture of retail units, including M&S Foodhall, Specsavers and Burger King amongst others. There is also an existing residential apartment within 14 Greenland Street immediately to the rear of the proposed store.

It is understood that the store opening hours are 0900 to 1900 Monday to Saturday and 1200 to 1800 on Sundays, and that the proposed building services plant will operate for a maximum of an hour before the store opens and after the store closes (0800 to 2000 Monday to Saturday and 1100 to 1900 on Sunday).

The proposed development site (indicative only) including the nearest noise sensitive receptors is identified in Figures 1 and 2 below and overleaf.

2.1 Local noise environment.

The surrounding noise climate is predominantly formed of road traffic noise from the immediate road network around the proposed store, in particular Camden High Street (A400).

It should also be noted that adjacent stores are open and as such, the noise climate to the rear of the proposed store is influenced by building services plant serving adjacent stores and vehicles using the service yard. In addition, the noise climate is also influenced by the refurbishment works being undertaken. Typical events included deliveries and general refurbishment activities. The measurement location was therefore selected in a suitable position away from existing building services plant noise to gain an accurate measure of the prevailing noise levels.

Figure 1: Plan of site (indicative only). © Google Earth.

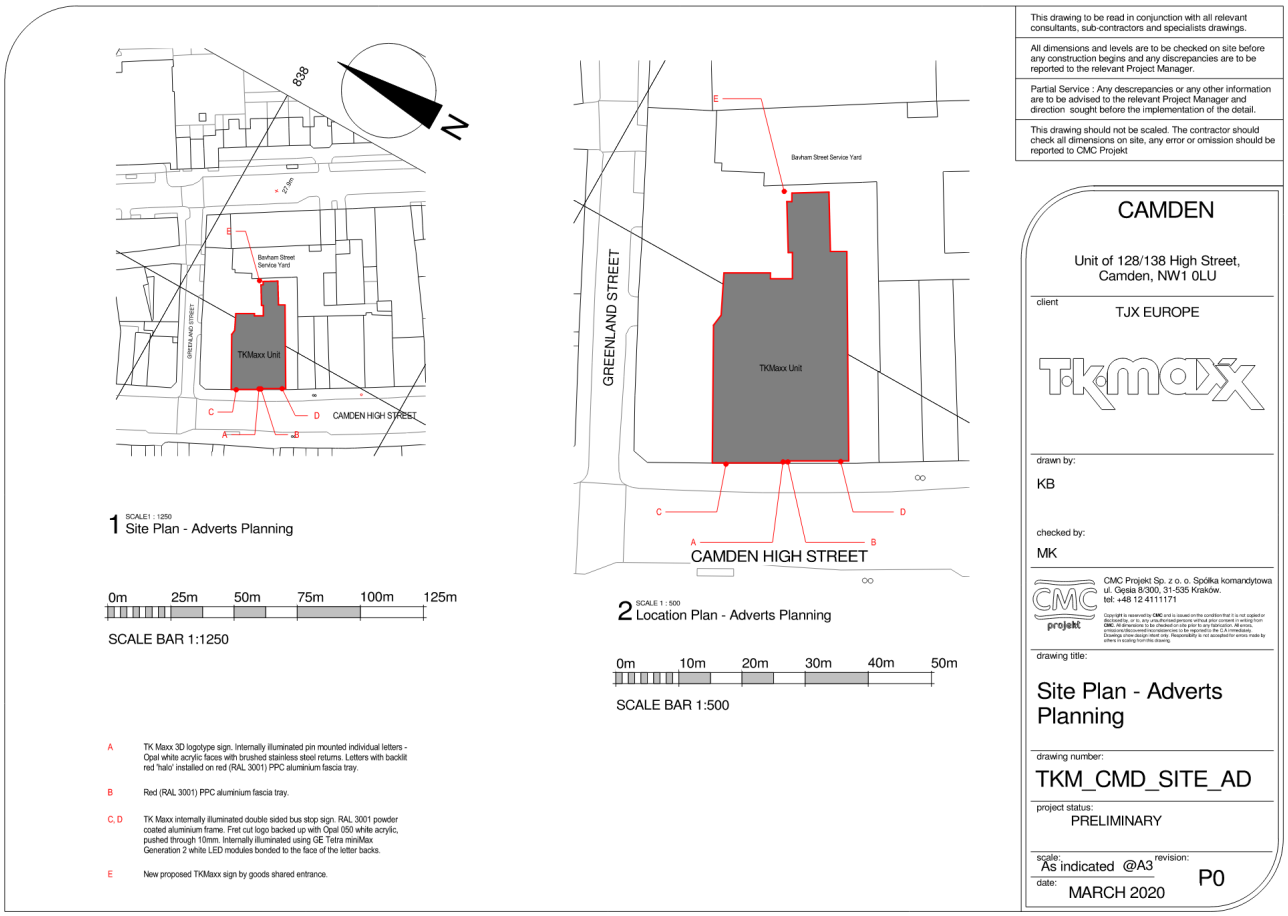


Figure 2: Proposed TK Maxx store location.

3. Basis of assessment.

3.1 National planning policy framework (NPPF): 2019.

The revised National Planning Policy Framework (1) published in July 2018 and updated in February and June 2019 sets out the Government's current planning policies for England and how these are expected to be applied. The NPPF supersedes the previous NPPF published in March 2012.

With regards to local noise and vibration, paragraph 180 states:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environmental, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development in doing so they should:

a. *Mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
b. *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
c. *Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."*

Reference is made to the DEFRA Noise Policy Statement for England 2010 (NPSfE). This latter document is intended to apply to all forms of noise other than that which occurs in the workplace and includes environmental noise and neighbourhood noise in all forms.

The NPSfE advises that the impact of noise should be assessed on the basis of adverse and significant effect but does not provide any specific guidance on assessment methods or limit sound levels. Moreover, the document advises that it is not possible to have *'a single objective noise-based measure…that is applicable to all sources of noise in all situations'.* It further advises that the sound level at which an adverse effect occurs is *'likely to be different for different noise sources, for different receptors and at different times'.*

In the absence of specific guidance for assessment of environmental noise within the NPPF and the NPSfE, it is considered appropriate to base assessment on current British Standards and national guidance. These are considered to be Local Authority guidance, BS 4142 (2), BS 8233 (3) and the World Health Organisations (4) (WHO) guidelines.

3.2 BS 4142: 2014 – Methods for rating and assessing industrial and commercial sound.

Current Government advice to Local Planning Authorities in both England and Wales makes reference to BS 4142 as being the appropriate guidance for assessing commercial operations and fixed building services plant noise. This British Standard provides an objective method for rating the likelihood of complaint from industrial and commercial operations. It also describes means of determining noise levels from fixed plant installations and determining the background noise levels that prevail on a site.

The assessment of impacts is based on the subtraction of the measured background noise level from the rating level determined. The rating level is the source noise level (either measured or predicted) corrected for tone or character (if necessary). The difference is compared to the following criteria to evaluate the impact.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact.
- A difference of around +5 dB indicates is likely to be an indication of an adverse impact.
- Where the rating level does not exceed the background noise level, this is an indication of the specific sound source having a low impact.

This method is only applicable for external noise levels.

3.3 Local planning policy.

3.3.1 Camden Local Plan 2017.

The Camden Local Plan adopted in July 2017 forms part of Camden's Development Plan and sets out the Council's planning policies as well as setting out the overall planning framework for the Borough.

In respect of noise, the Local Plan contains a single relevant policy, *Policy A4.*

3.3.1.1 Policy A4 – Noise and vibration.

Policy A4 states the following:

"The Council will seek to ensure that noise and vibration is controlled and managed.

Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:

a. *Development likely to generate unacceptable noise and vibration impacts; or*
b. *Development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.*

We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development."

3.3.1.2 Appendix 3 – Noise thresholds.

With regards to industrial / commercial noise sources, Appendix 3 of the Camden Local Plan states the following:

"Where appropriate and within the scope of the document it is expected that BS 4142: 2014 will be used. For such cases a 'Rating Level' of 10 dB below background (15 dB if tonal components are present) should be considered as the design criterion."

The Local Plan continues to state:

"… if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required."

3.4 Proposed standards.

3.4.1 Building services – noise.

On the basis of guidance provided within Appendix 3 of the Camden Local Plan, all building services plant should be designed to achieve the following noise emission limits.

Description of noise source	Noise emission limit
Building services plant	$L_{Ar,Tr} = L_{A90,T} - 10$ dB

Table 1: Noise emission limits for building services.

Additionally, for plant noise that is tonal, contains a specific character or is intermittent, the limits of Table 1 above need to include a character correction as set out within the Camden Local Plan.

4. Environmental noise survey.

An acoustic survey has been carried out at the site to establish the prevailing environmental noise conditions local to the site, so as to determine building services plant noise emission limits.

4.1 Methodology.

The survey comprised five days of unattended automatic noise measurements by a single noise monitor. The position of this monitor is shown as position L1 in Figure 3 below. This measurement position was located to the northern boundary of the proposed store on an escape stair adjacent to the nearest noise sensitive receptor at 14 Greenland Street.

Measurements recorded consisted of fifteen-minute samples of ambient noise levels ($L_{Aeq,15min}$ in dB), maximum noise levels ($L_{Amax,15min}$ in dB) and background noise levels ($L_{A90,15min}$ in dB) between Thursday 23rd July 2020 and Tuesday 28th July 2020.

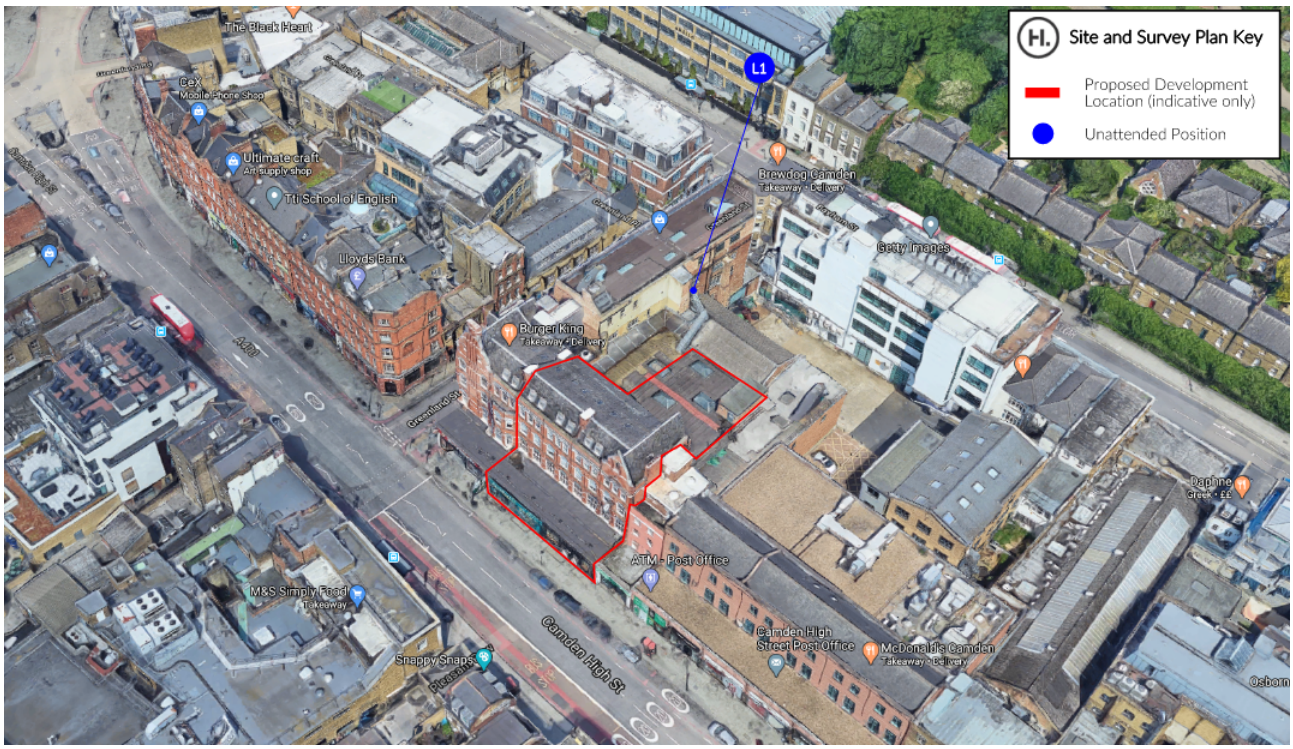


Figure 3: Measurement locations. © Google Earth.

The measurement instrumentation used is listed in Appendix B attached and a general acoustic terminology is provided in Appendix A.

During the measurement period, temperatures remained warm with some precipitation and winds varying in both direction and strength.

4.2 Results summary.

A time history of the L_{Aeq}, L_{A90} and L_{Amax} from the unattended measurements recorded at position L1 is shown in Appendix C attached.

The results of the unattended measurements at position L1 have been calculated into daytime ($L_{Aeq,16hr}$) and night-time ($L_{Aeq,8hr}$) equivalent levels, and are shown with the associated measured minimum background noise level ($L_{A90,T}$) and maximum instantaneous measured noise level ($L_{Amax,T}$) in Table 2.

It should be noted that the minimum daytime ($L_{A90,1hr}$) background noise level shown below is the lowest arithmetic average of the measured background noise levels ($L_{A90,15min}$) in an hourly period. Similarly, the maximum events shown in Table 2 are the maximum measured in each corresponding period.

Measurement date	Time	Position L1					
		Daytime			Night-time		
		$L_{Aeq,16hr}$ dB	Min $L_{A90,1hr}$ dB	Max $L_{Amax,T}$ dB	$L_{Aeq,8hr}$ dB	Min $L_{A90,15min}$ dB	Max $L_{Amax,T}$ dB
Thursday 23rd July 2020	1400 – 2300	58	48	92	-	-	-
23rd / 24th July 2020	2300 – 0700	-	-	-	52	46	78
Friday 24th July 2020	0700 – 2300	61	50	92	-	-	-
24th / 25th July 2020	2300 – 0700	-	-	-	52	48	82
Saturday 25th July 2020	0700 – 2300	55	49	88	-	-	-
25th / 26th July 2020	2300 – 0700	-	-	-	50	46	74
Sunday 26th July 2020	0700 – 2300	54	48	76	-	-	-
26th / 27th July 2020	2300 – 0700	-	-	-	51	47	81
Monday 27th July 2020	0700 – 2300	63	48	93	-	-	-
27th / 28th July 2020	2300 – 0700	-	-	-	51	46	77
*Tuesday 28th July 2020**	*0700 – 1145*	*69*	*50*	*86*	-	-	-

Table 2: Measured noise levels at position L1.

*Note *: Measurements impacted by external works to proposed store.*

The results of the unattended measurements at position L1 have also been calculated into four separate time periods: morning, daytime, evening and night-time. The respective daytime period corresponds with the period in which the proposed plant will be in operation (0800 to 2000 Monday to Saturday and 1100 to 1900 on Sunday). As before, the minimum daytime background noise level ($L_{A90,1hr}$) shown below is the lowest arithmetic average of the measured background noise levels ($L_{A90,15min}$) in an hourly period.

Measurement date	Time	Position L1							
		Morning		Daytime		Evening		Night-time	
		$L_{Aeq,T}$ dB	Min $L_{A90,1hr}$ dB	$L_{Aeq,T}$ dB	Min $L_{A90,1hr}$ dB	$L_{Aeq,T}$ dB	Min $L_{A90,1hr}$ dB	$L_{Aeq,8hr}$ dB	Min $L_{A90,15min}$ dB
Thursday 23rd July 2020	1400 – 2300	-	-	59	53	54	48	-	-
23rd / 24th July 2020	2300 – 0700	-	-	-	-	-	-	52	46
Friday 24th July 2020	0700 – 2300	58	50	61	52	56	50	-	-
24th / 25th July 2020	2300 – 0700	-	-	-	-	-	-	52	48
Saturday 25th July 2020	0700 – 2300	54	50	55	51	55	49	-	-
25th / 26th July 2020	2300 – 0700	-	-	-	-	-	-	50	46
Sunday 26th July 2020	0700 – 2300	52	48	54	52	54	48	-	-
26th / 27th July 2020	2300 – 0700	-	-	-	-	-	-	51	47
Monday 27th July 2020	0700 – 2300	57	52	64	53	54	48	-	-
27th / 28th July 2020	2300 – 0700	-	-	-	-	-	-	51	46
*Tuesday 28th July 2020**	*0700 – 1100*	*53*	*50*	*70*	*52*	-	-	-	-

Table 3: Measured noise levels at position L1.

*Note *: Measurements impacted by external works to proposed store.*

5. Noise sensitive areas.

A noise sensitive area is defined as landscapes or buildings where the occupiers are likely to be sensitive to noise created by new plant installed as part of the proposed development, including residential areas. The nearest sensitive receptor is therefore identified as the existing residential dwelling within 14 Greenland Street (approximately 18m to the north of the proposed plant zone), as indicated in Figure 4 below.

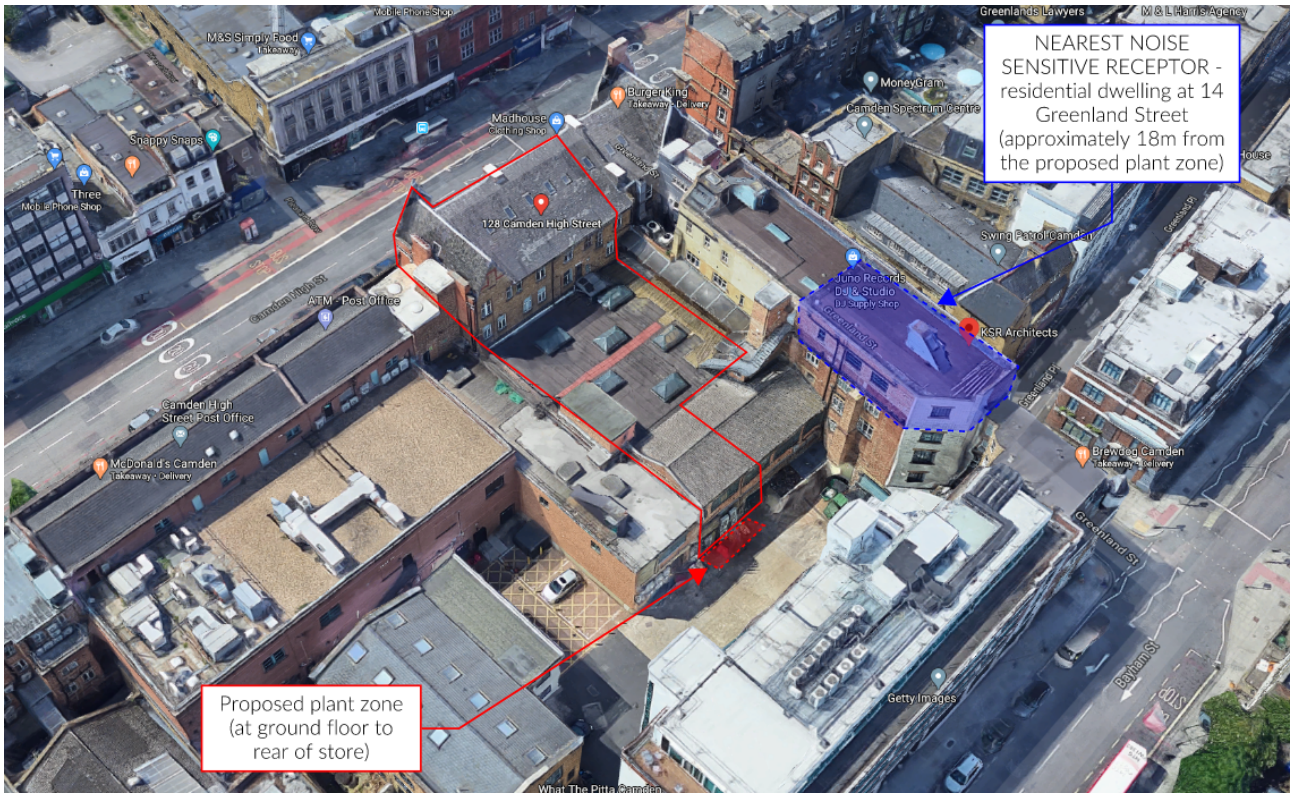


Figure 4: Nearest noise sensitive receptor. © Google Earth.

6. Noise emissions of fixed plant.

Noise levels due to building services serving the proposed development are advised to meet the following noise level criteria shown below in Table 4 one metre from the nearest noise sensitive receptor as identified in Section 5. These are based on the lowest background noise levels during the time in which the proposed plant will be in operation measured at position L1.

Period	Lowest Prevailing Background Noise Level $L_{A90,1hr}$ dB	Noise Emission Limit Calculation $L_{Ar,Tr}$ dB
Monday to Saturday (0800 to 2000)	51	41
Sunday (1100 to 1900)		

Table 4: Building services noise emission limits.

It should be noted that each of the limits stated above are the combined operational noise levels of plant. As such, the combined operational noise levels of all plant are required to achieve the noise limits defined above.

For plant noise that is tonal, contains a specific character or is intermittent, the limits of Table 4 above need to include character correction as set out within the Camden Local Plan.

7. Building services plant.

The current proposal is understood to locate two condenser units within a palisade fence to the rear of the store as well as an internal air handling unit (within the store room) with connections to the façade within the plant zone, as shown in Figure 5 below.

It is understood that the store opening hours 0900 to 1900 Monday to Saturday and 1200 to 1800 on Sundays, and that the proposed building services plant will operate for a maximum of an hour before the store opens and after the store closes (0800 to 2000 Monday to Saturday and 1100 to 1900 on Sunday).

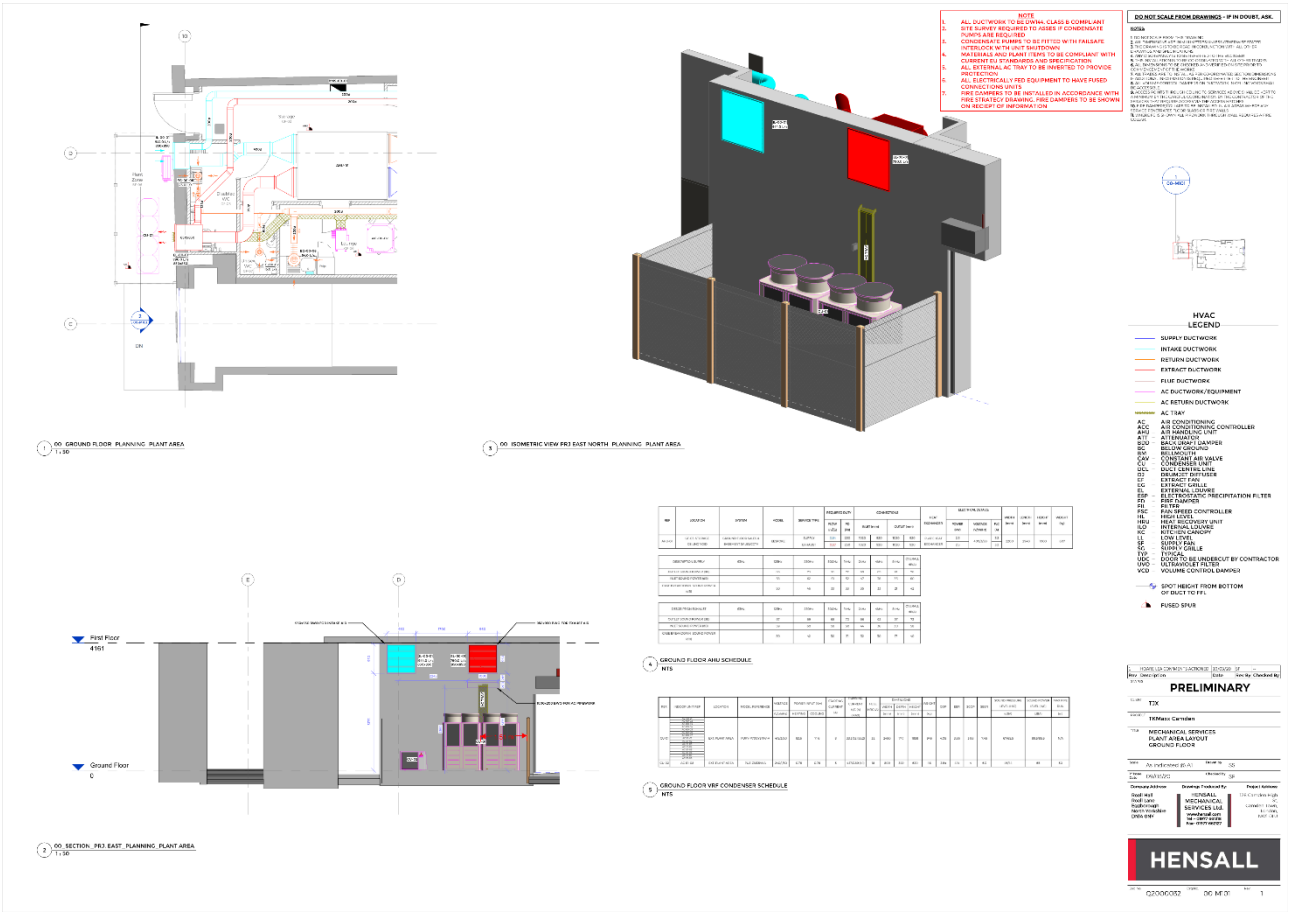


Figure 5: Indicative plant layout.

An assessment of the noise emissions from the condenser units and air handling unit has been undertaken to ensure compliance with the building noise emission limits provided in Table 4 above. The manufacturers' acoustic data has been used for each item of plant and is provided in Appendices E and F attached. In addition, a schedule of the proposed condenser units is provided in Appendix D.

The resultant sound pressure level one metre from the nearest window of the residential dwelling at 14 Greenland Street (approximately 18m from the nearest part of the proposed plant zone) has been calculated using the principles of ISO 9613-2 (5) and compared to the defined building services noise emission limits.

The most appropriate way of determining noise emissions from multiple items of building services plant is through the use of the individual source sound power levels. Whilst this data is not readily available, an area correction (based on the surface area at one metre from the unit) can be applied to the sound pressure levels to estimate the source sound power levels. The following table summarises the manufacturers stated sound pressure level at one metre and the predicted sound power level of each condenser unit.

Condenser unit reference	Model	Manufacturers sound pressure level at 1m dB(A)	Predicted sound power level L_{wA} dB
CU-01	PURY-P700YSNW-A	66	83
CU-02	PUZ-ZM35VKA	46	60

Table 5: Condenser units - predicted sound power levels.

The following table provides the fan sound power levels for the proposed air handling unit.

AHU	Sound power level per octave band frequency in Hz dB							L_{wA} dB
	125	250	500	1000	2000	4000	8000	
Supply - Inlet	58	62	61	52	47	38	35	60
Extract - Outlet	67	69	68	70	66	62	57	73

Table 6: Air Handling Unit (AHU) - sound power levels.

The methodology used to determine noise emissions at the nearest noise sensitive receptor for each item of plant are as follows:

1. Apply a distance correction to the sound power level ($L_{w(man)}$) for the distance to the noise sensitive receptor (r) assuming hemispherical sound propagation:

$$Distance\ Correction = 20 \log_{10} r + 8$$

4. Derive L_p at receiver location based on the manufacturers sound power level ($L_{w(man)}$) using following equation:

$$L_{p(receiver)} = L_{w(man)} - Distance\ Correction$$

5. Predict sound pressure level for all units in operation.

Condenser unit reference	Estimated L_{wA} dB	Distance correction dB	Predicted sound pressure level dB(A)
CU-01	83	-33	50
CU-02	60	-33	27
Predicted sound pressure level (combined)			50

Table 7: Predicted noise level from condensers at 14 Greenland Street.

AHU reference	L_{wA} dB	Distance correction dB	Directivity factor (based on louvre area)	Predicted sound pressure level dB(A)
Supply – Inlet	60	-33	+8	35
Extract – Outlet	73	-33	+8	48
Predicted sound pressure level (combined)				48

Table 8: Predicted noise level from AHU at 14 Greenland Street.

*Note *: Directivity factor derived from guidance provided within "Fläkt Woods Practical Guide to Noise Control".*

From Tables 7 and 8 it can be seen that the predicted sound pressure level contributions at Greenland Street is 50 dB(A) from the condenser units and 48 dB(A) from the air handling unit (AHU). Combining these predictions

results in a total noise level of 52 dB(A). Comparison with the proposed external noise limits is presented in Table 9 below.

Period	Plant noise limit $L_{Ar,Tr}$ dB	Predicted plant noise level $L_{Aeq,T}$ dB
Monday to Saturday (0800 to 2000)	41	52
Sunday (1100 to 1900)		

Table 9: Plant noise limit and predicted noise level – 14 Greenland Street.

From Table 9 it can be seen that the combined noise emissions exceed the defined noise emissions limits. As such, noise control measures of the air handling unit and condenser units (in particular condenser unit 01) are required in order to provide adequate attenuation.

In order to provide combined noise emissions in compliance with the defined noise emission limits, noise emissions from the supply and extract fan are required to be reduced by a minimum of 9 and 18 dB(A) respectively such that they do not contribute to the combined noise emission levels. In order to provide this reduction, a silencer of length 600mm and free area 50% is required on the supply fan and a silencer of length 600mm and free area 33% is required on the extract fan.

In order to provide adequate attenuation of condenser unit 01, three options are provided for consideration:

1) Provide a solid acoustic screen (minimum 20 kg/m^2) to prevent a direct line of sight between the condenser unit and the residential window at 14 Greenland Street. In practice, this could be achieved with a solid acoustic screen with an angled return on the top, as notionally shown in Figure 6 below.

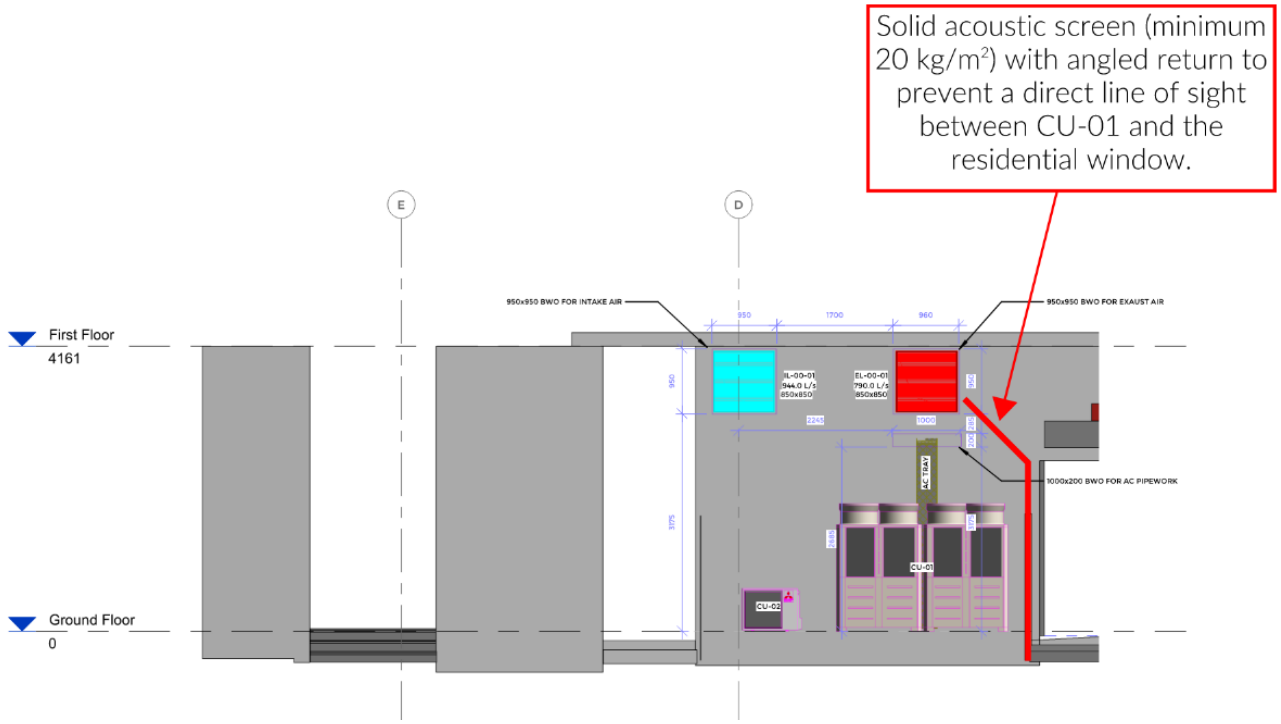


Figure 6: Acoustic screen location.

2) Provide the condenser unit with a full acoustic kit as manufactured by Mitsubishi, as shown in Figure 7 below.

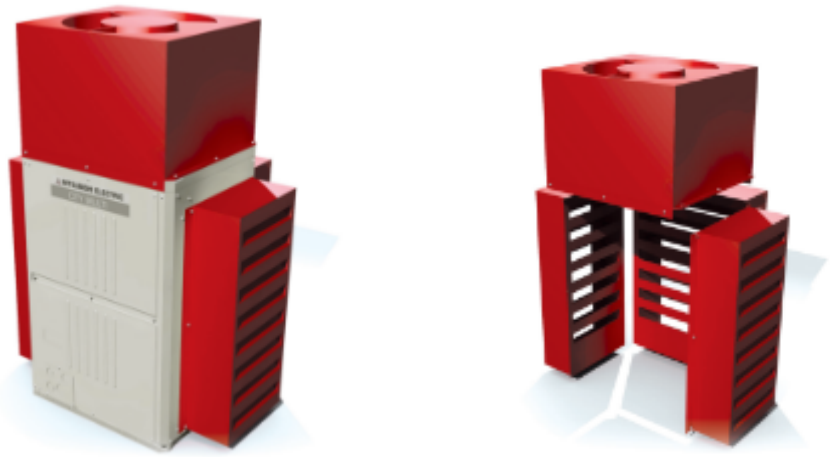


Figure 7: Mitsubishi acoustic kit.

3) Reselect the condenser unit to have maximum sound power level of L_{wA} 74 dB.

The provision of the above mitigation measures is sufficient to reduce noise emissions from the proposed plant to 41 dB, and therefore ensure that noise emissions are in compliance with the noise emission limits derived in Table 4.

Noise levels receptors located at further distances from the proposed plant zone would be lower than those predicted above and therefore acceptable in terms of their noise exposure.

It should be noted that the assessment provided within this Section is considered worst case as it assumes that all plant is operating at maximum duty. In reality, this is extremely unlikely and therefore noise levels are likely to be significantly lower during most periods of the working day.

8. Summary & conclusions.

Hoare Lea has conducted an environmental noise survey at the proposed TK Maxx Store at 128-138 Camden High Street. Unattended noise monitoring throughout a typical five-day period was conducted.

Background noise levels typical of the daytime have been measured and used to define building services plant noise emission limits at the nearest noise sensitive receptor. The nearest noise sensitive receptors has been identified as an existing residential dwelling within 14 Greenland Street to the north of the proposed store.

It is understood that the store opening hours are 0900 to 1900 Monday to Saturday and 1200 to 1800 on Sundays, and that the proposed building services plant will operate for a maximum of an hour before the store opens and after the store closes (0800 to 2000 Monday to Saturday and 1100 to 1900 on Sunday).

During the time in which the proposed plant will be operational, the combined building services plant noise emission contribution limit advised is 41 dB(A), one metre from the nearest noise sensitive receptor.

An assessment of noise associated with the proposed items of building services plant has been undertaken. The predicted noise level exceeds the defined noise emission limit by up to 11 dB(A). As such, noise control measures of the air handling unit and condenser unit 01 is required.

In order to provide sufficient attenuation of the supply and extract fan of the air handling unit, silencers of length 600mm and free area 50% and 33% are required.

In order to provide sufficient attenuation of condenser unit 01, three options have been provided for consideration:

1) Provide a solid acoustic screen (minimum 20 kg/m^2) to prevent a direct line of sight between the condenser unit and the residential window at 14 Greenland Street. In practice, this could be achieved with a solid acoustic screen with an angled return on the top.
2) Provide the condenser unit with a full acoustic kit as manufactured by Mitsubishi.
3) Reselect the condenser unit to have maximum sound power level of L_{wA} 74 dB.

Incorporation of the above mitigation measures is sufficient to provide noise emissions in compliance with the defined noise emission limit.

The guidance provided within this report is sufficient to satisfy the requirements of the Camden Council, in our opinion.

This assessment has been conducted by Tom Hills who is a Member of the Institute of Acoustics and holds a First-Class Masters in Acoustic Engineering. Hoare Lea Acoustics are also a member organisation of the ANC.

9. References.

1. *National Planning Policy Framework, Department for Communities and Local Government, February & June 2019.*

2. *BS 4142: 2014 + A1: 2019: 'Method for rating and assessing industrial and commercial sound'.*

3. *BS 8233: 2014, "Guidance on Sound Insulation and Noise Reduction for Buildings", BSI.*

4. *World Health Organisation (WHO) - Environmental Noise Guidelines for the European Region, 2018.*

5. *ISO 9613-2: 1996, 'Acoustics - Attenuation of Sound during Propogation Outdoors - Part 2'.*

Appendix A – Acoustic terminology.

Sound
Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air.

The Sound Pressure
The Sound Pressure is the force (N) of sound on a surface area (m2) perpendicular to the direction of the sound. The SI-units for the Sound Pressure are Nm-2 or Pa (Pascal).

Sound is measured with microphones responding proportionally to the sound pressure – p. The power is proportional to the square of the sound pressure.

The Sound Pressure Level
The human ear has an approximately logarithmic response to sound pressure over a very large dynamic range. The lowest audible sound pressure approximately 2 x 10-5 Pa (2 ten billionths of an atmosphere) and the highest is approximately 100 Pa.

It is therefore convenient to express the sound pressure as a logarithmic decibel scale related to this lowest human audible sound, where:

$$L_p = 10 \log\left(\frac{p^2}{p_{ref}^2}\right) = 10 \log\left(\frac{p}{p_{ref}}\right)^2 = 20 \log\left(\frac{p}{p_{ref}}\right)$$

Where: L_p *= sound pressure level (dB)*

p *= sound pressure (Pa)*

p_{ref} *= 2 x 10-5 – reference sound pressure (Pa)*

In accordance with the logarithmic scale, doubling the sound pressure level gives an increase of 6 dB.

Decibel (dB)
The decibel is the unit used to quantify sound pressure levels as well as sound intensity and power levels.

In accordance with the logarithmic scale, an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pa). Subjectively, this increase would correspond to a doubling of the perceived loudness of the sound.

Sound Pressure Level of Some Common Sources
An indication of the range of sound levels commonly found in the environment is given in the following Table.

Source	Sound Pressure Level dB
Threshold of Hearing	0
Rustling Leaves	20
Quiet Whisper	30
Home	40
Quiet Street	50
Conversation	60
Inside a Car	70
Loud Singing	80
Motorcycle (10m)	90
Lawn Mower (1m)	100
Diesel Truck (1m)	110
Amplified Music (1m)	120
Jet Plane (1m)	130

Frequency
The rate at which the pressure fluctuations occur determines the pitch or frequency of the sound. The frequency is expressed in Hertz (Hz) or cycles per second.

Octave and Third Octave Bands
An octave is the interval between two points where the frequency at the second point is twice the frequency of the first.

There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250 Hz and 500 Hz.

Third octave bands provided a fine resolution by dividing each octave band into three bands. For examples, third octave bands would be 160 Hz, 250 Hz and 315 Hz for the same 250 Hz octave band.

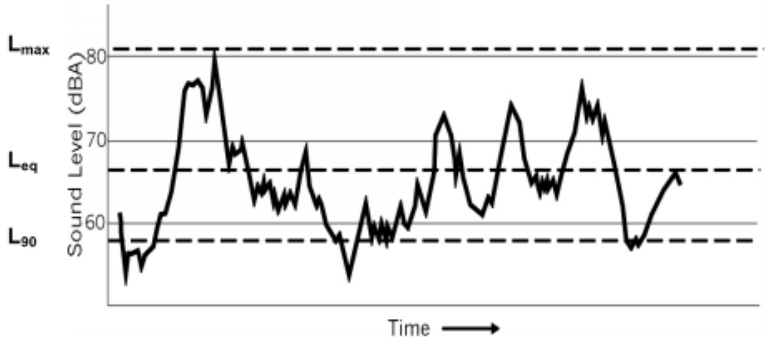
The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequency than to low frequencies within the range. This is the basis of the A-weighting.

A-Weighting
The A-weighting is a correction term applied to the frequency range in order to mimic the sensitivity of the human ear to noise. It is generally used to obtain an overall noise level from octave or third octave band frequencies.

An A weighted value would be written as dB(A), or including A within the parameter term.

Noise Units
In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as five minutes, the statistically determined results being used to quantify various aspects of the noise.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of noise can be described by several different levels. The most common of these are described below.



$L_{eq,T}$
The $L_{eq,T}$ is a parameter defined as the equivalent continuous sound pressure level over a defined time period 'T'. It is the sound pressure level equivalent to the acoustic energy of the fluctuating sound signal.

The $L_{eq,T}$ can be thought of as an 'average' sound pressure level over a given time period (although it is not an arithmetic average). Typically the $L_{eq,T}$ will be an A-weighted noise level in dB(A) and is commonly used to describe all types of environmental noise sources.

$L_{01,T}$
The $L_{01,T}$ is a parameter defined as the sound pressure level exceeded for 1% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter.

$L_{10,T}$
The $L_{10,T}$ is a parameter defined as the sound pressure level exceeded for 10% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe road traffic noise.

$L_{90,T}$
The $L_{90,T}$ is a parameter defined as the sound pressure level exceeded for 90% of the measurement period 'T'.

It is a statistical parameter and cannot be directly combined to other acoustic parameter and is generally used to describe the prevailing background noise level.

$L_{max,T}$
The $L_{max,T}$ is a parameter defined as the maximum noise level measured during the specified period 'T'.

Specific Noise Level, $L_{Aeq,Tr}$.
This is the equivalent continuous A-weighted sound pressure level at the assessment position due to a specific noise source operating over a given time interval.

Free Field
A measurement taken in the free field is at least 3.5m from reflecting vertical surfaces and 1.2m from the ground.

Façade
A measurement is influenced by the reflection of sound from the façade of a building within 3.5m. A façade measurement is made 1m in front of the vertical building surface.

R_w
A single-number quantity which characterizes the airborne sound insulation of a material or building element in the laboratory. See BS EN ISO 717-1: 1997.

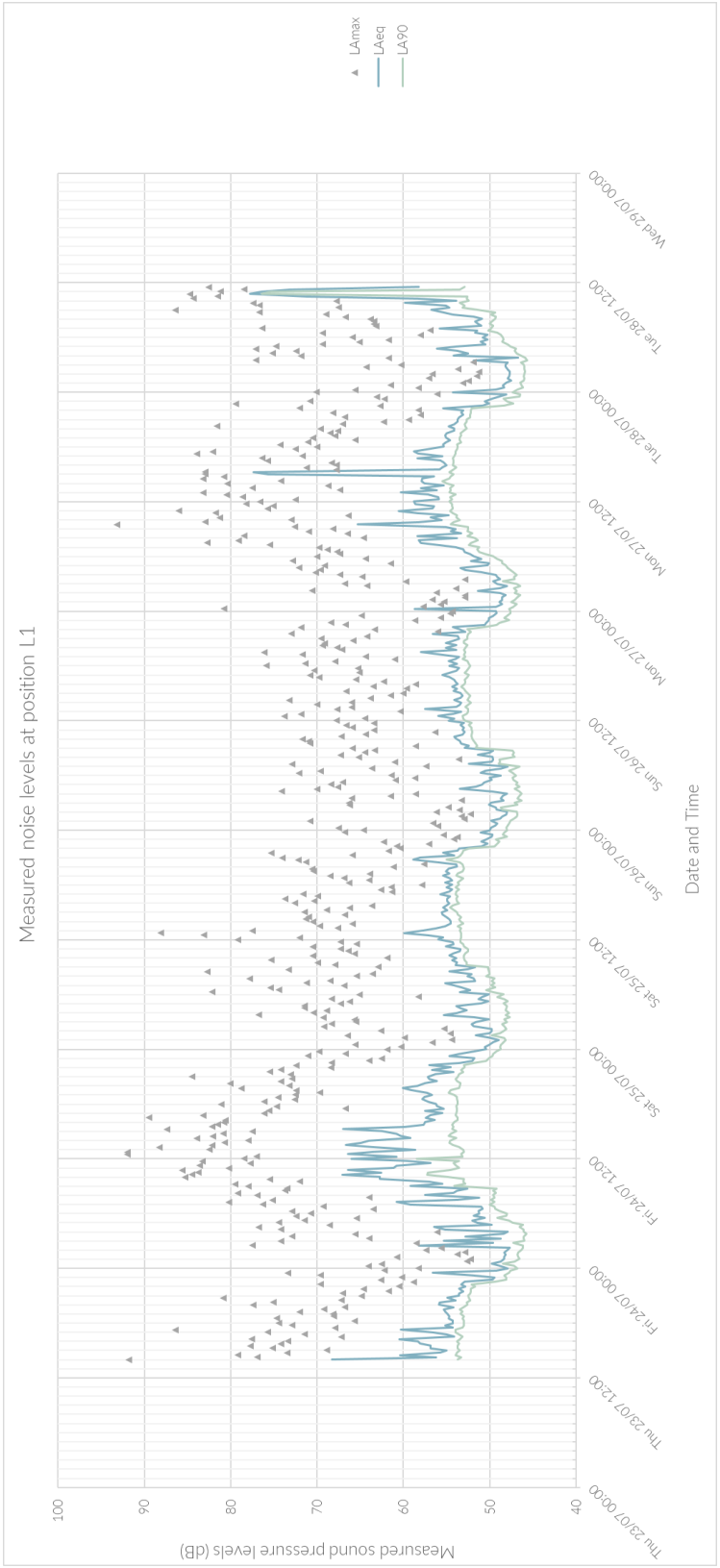
Appendix B – List of measurement equipment.

Environmental Noise Survey
Sound Level Meter (Position L1 – Unattended)

- Rion NL-52 Sound Level Meter (Serial Number 00342839)
- Rion NH-25 Pre-Amplifier (Serial Number 42867)
- Rion UC-59 Microphone (Serial Number 06360)

Sound level meters were field calibrated before and after noise survey and no discernible variations occurred.

Appendix C – Time history at position L1.



Appendix D – Condenser unit schedule.

REF.	INDOOR UNIT REF	LOCATION	MODEL REFERENCE	VOLTAGE	POWER INPUT (kw)		STARTING CURRENT	RUNNING CURRENT H/C (A) (MAX)	FUSE HRC (A)	DIMENSIONS			WEIGHT	COP	EER	SCOP	SEER	SOUND PRESSURE LEVEL (H/C)	SOUND POWER LEVEL (H/C)	MAX PIPE RUN
										WIDTH	DEPTH	HEIGHT								
				(V/ph/Hz)	HEATING	COOLING	(A)			(mm)	(mm)	(mm)	(kg)					(dBA)	(dBA)	(m)
CU-01	AC-B1-01 AC-B1-02 AC-B1-03 AC-B1-04 AC-B1-05 AC-B1-06 AC-B1-07 AC-B1-08 AC-B1-09 AC-B1-10 AC-B1-11 AC-B1-12 AC-B1-13 AC-B1-14 AC-B1-15 AC-B1-16 AC-B1-17 AC-B1-18 AC-B1-19	EXT. PLANT AREA	PURY-P700YSNW-A	415/3/50	83.6	71.6	8	33.3/32 (55.2)	32	2480	740	1858	946	4.08	3.86	3.88	7.45	67/65.5	89.5/85.5	N/A
CU-02	AC-B1-08	EXT. PLANT AREA	PUZ-ZM35VKA	240/1/50	0.76	0.76	5	4.17/3.89 (4.1)	16	809	300	630	46	3.94	4.14	4	6.3	46/44	65	50

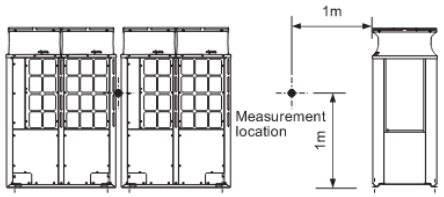
Appendix E – Manufacturers information – Condenser units.

5. SOUND LEVELS

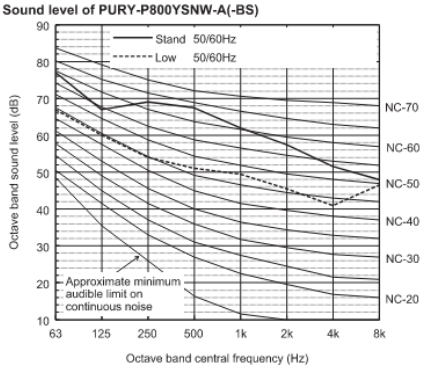
Outdoor units

PURY-P-Y(S)NW-A

Measurement condition
PURY-P700, 750, 800, 850, 900YSNW-A(-BS)



Sound level of PURY-P800YSNW-A(-BS)

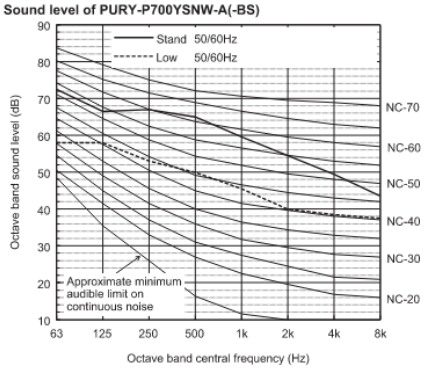


		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	50/60Hz	77.0	67.0	69.0	67.5	62.0	57.5	51.5	48.0	68.0
Low noise mode	50/60Hz	67.0	60.0	54.0	61.0	49.5	45.5	41.0	46.5	55.0

When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

CU-01

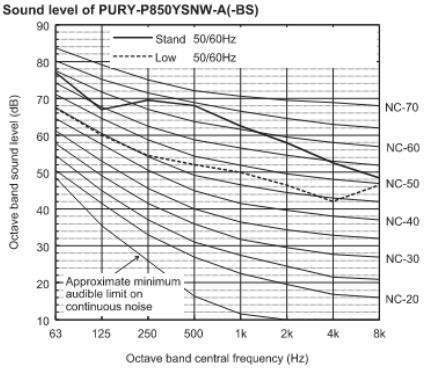
Sound level of PURY-P700YSNW-A(-BS)



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	50/60Hz	72.5	66.5	67.0	65.0	59.5	54.5	49.5	43.5	65.5
Low noise mode	50/60Hz	58.0	58.0	53.0	50.0	45.5	40.0	38.5	37.5	52.0

When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

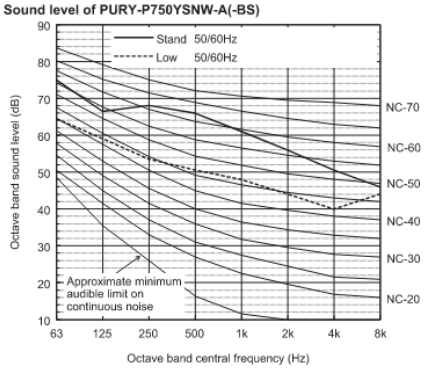
Sound level of PURY-P850YSNW-A(-BS)



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	50/60Hz	77.0	67.0	69.5	68.0	62.5	58.0	52.5	48.5	68.5
Low noise mode	50/60Hz	67.5	60.0	54.5	52.0	50.0	46.5	42.0	46.5	55.5

When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

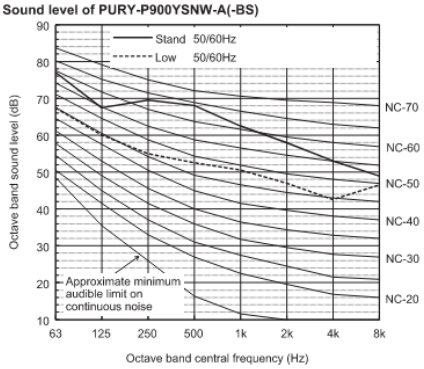
Sound level of PURY-P750YSNW-A(-BS)



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	50/60Hz	75.0	66.5	68.0	66.0	61.0	56.0	50.5	46.0	67.0
Low noise mode	50/60Hz	64.5	59.0	53.5	50.5	48.0	44.0	40.0	44.0	54.0

When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

Sound level of PURY-P900YSNW-A(-BS)



		63	125	250	500	1k	2k	4k	8k	dB(A)
Standard	50/60Hz	77.0	67.5	69.5	68.0	62.5	58.0	53.0	49.0	68.5
Low noise mode	50/60Hz	67.5	60.0	55.0	52.5	50.5	47.0	42.5	46.5	56.0

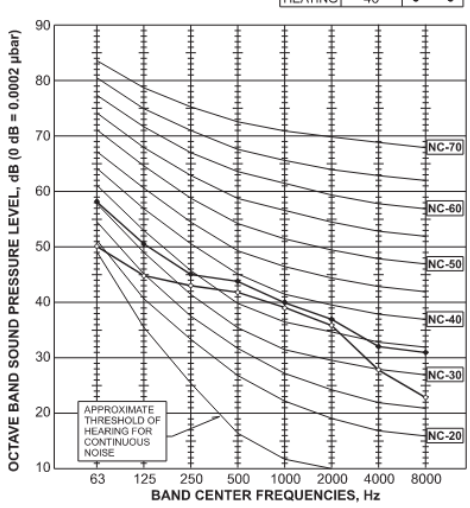
When Low noise mode is set,the A/C system's capacity is limited. The system could return to normal operation from Low noise mode automatically in the case that the operation condition is severe.

•Depending on the operation conditions, the unit generates noise caused by valve actuation, refrigerant flow, and pressure changes when operating normally. Please consider to avoid location where quietness is required.
For BC controller, it is recommended to be installed in places such as ceilings of corridor, rest rooms and plant rooms.

5-3. NOISE CRITERION CURVES

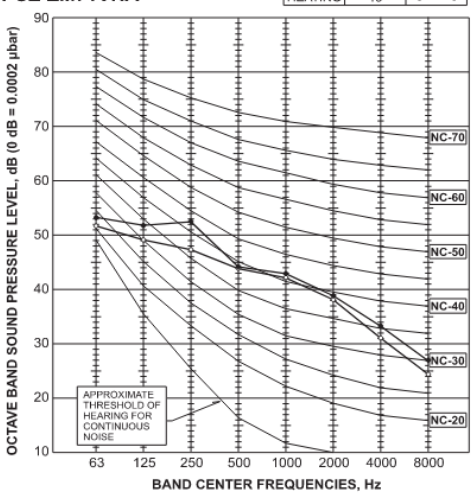
CU-02
PUZ-ZM35VKA
PUZ-ZM50VKA

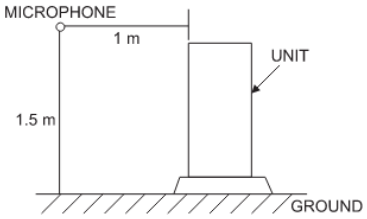
MODE	SPL(dB)	LINE
COOLING	44	
HEATING	46	



PUZ-ZM60VHA
PUZ-ZM71VHA

MODE	SPL(dB)	LINE
COOLING	47	
HEATING	49	





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Appendix F – Manufacturers information – AHU.

REF	LOCATION	SYSTEM	MODEL	SERVICE TYPE	REQUIRED DUTY		CONNECTIONS				HEAT EXCHANGER	ELECTRICAL DETAILS:			WIDTH (mm)	LENGTH (mm)	HEIGHT (mm)	WEIGHT (kg)
					FLOW (m^3/s)	PD (Pa)	INLET (mm)		OUTLET (mm)			POWER (kW)	VOLTAGE (V/ph/Hz)	FLC (A)				
AHU-01	GF-03: STORAGE CEILING VOID	GROUND FLOOR SALES & BASEMENT SALES/CCTV	BESPOKE	SUPPLY	0.84	250	1020	920	1020	920	PLAT EHEAT EXCHANGER	2.5	400/3/50	3.2	2200	2940	1000	607
				EXHAUST	0.67	250	1020	920	1020	920		2.5		3.2				

DESCRIPTION SUPPLY	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	OVERALL dB(A)
OUTLET SOUND POWER (dB)		66	73	71	72	69	65	61	76
INLET SOUND POWER (dB)		58	62	61	52	47	38	35	60
CASE BREAKDOWN SOUND POWER (dB)		50	46	33	33	35	33	21	42

DESCRIPTION EXHAUST	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	OVERALL dB(A)
OUTLET SOUND POWER (dB)		67	69	68	70	66	62	57	73
INLET SOUND POWER (dB)		59	60	58	50	44	36	30	58
CASE BREAKDOWN SOUND POWER (dB)		50	42	30	31	32	30	17	40

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